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A STUDY OF PHONEME-GRAPHEME CORRESPONDENCE IN MONOSYLLABIC WORDS.

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THE SPELLINGS OF ALL MONOSYLLABIC WORDS IN THE CORE VOCABULARY OF AMERICAN ENGLISH WERE ANALYZED TO DETERMINE THE DEGREE OF CORRESPONDENCE BETWEEN A PHONEME AND A SINGLE GRAPHEMIC REPRESENTATION IN THIS SET OF WORDS. A PHONEMIC CLASSIFICATION WAS DEVISED, AND COMPUTER TECHNOLOGY WAS USED TO ANALYZE THE PHONEME-GRAPHEME CORRESPONDENCE OF THESE WORDS IN TWO WAYS--(1) THE SPELLING OF A GIVEN PHONEME ANY PLACE IN MONOSYLLABIC WORDS AND (2) THE SPELLING OF A GIVEN PHONEME IN INITIAL, MEDIAL, AND FINAL POSITION IN MONOSYLLABIC WORDS. SPELLINGS OF EACH PHONEME WERE RANK-ORDERED TO DETERMINE THE ODDS THAT A GIVEN PHONEME WOULD BE REPRESENTED BY A PARTICULAR GRAPHIC SYMBOL AT LEAST 80 PERCENT OF THE TIME IN THE WORDS STUDIED. THE PHONEMES LARGELY RESPONSIBLE FOR THE ORTHOGRAPHY'S FAILURE TO APPROXIMATE THE ALPHABETIC PRINCIPLE IN MONOSYLLABIC WORDS ARE THE LONG VOWEL PHONEMES AND CERTAIN DIPHTHONGS. KNOWLEDGE OF CONSONANT AND SHORT VOWEL PHONEMES CAN HELP CHILDREN UNDERSTAND THE NATURE OF ORTHOGRAPHY AND APPLY THIS KNOWLEDGE TO SPELLING. ALTHOUGH EDUCATIONAL IMPLICATIONS ARE SUGGESTED, THE STUDY IS FUNDAMENTALLY A DESCRIPTION OF THE ALPHABETIC NATURE OF THE ORTHOGRAPHY OF AMERICAN-ENGLISH WORDS. THIS PAPER WAS PRESENTED AT THE INTERNATIONAL READING ASSOCIATION CONFERENCE (SEATTLE, MAY 1961). (RH)

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A STUDY OF PHONEME-GRAPHEME CORRESPONDENCES IN MONOSYLLABIC WORDS

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OVERVIEW

In this study, the spellings of all monosyllabic words in the core vocabulary of American English were analyzed in order to determine the degree to which the orthography approximates the alphabetic principle (i.e., a one-to-one correspondence between a phoneme and a single graphemic representation) in this set of words. Most beginning spelling and reading programs for a number of reasons typically use vocabularies comprised largely of monosyllabic words. With the proliferation of linguistically oriented spelling and reading programs in which pupils are guided toward gaining an understanding of the alphabetic structure of our writing system,

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it seems important to describe the orthography of those words which are the basis for the child's introduction to a structural analysis of American-English orthography.

MONOSYLLABIC WORDS AND THE ORTHOGRAPHY

Monosyllabic words constitute a rich and functional part of our language. Indeed, 340 of the first five hundred most frequently used American-English words have monosyllabic structures (5). Why is there a predilection to employ monosyllabic words with high frequency in our language? It seems likely that it is simply easier to remember and to pronounce monosyllabic words than other words having more complex structures. This "principle of least effort" (6) in fact, probably accounts for such highly functional monosyllabic words as phone, zoo, ad, lab, math, and bus that are clipped forms of polysyllabic words.

Monosyllabic words are therefore characterized by their functionality and their structural simplicity, and both of these characteristics cause monosyllabic words to be quite useful in beginning spelling and reading programs. Each characteristic, in fact, can be used as the most basic rationale for the selection of words for beginning spellers and readers.

In terms of functionality, it is generally assumed that the child's introduction to written language should begin with the study of words he will most likely be acquainted with and which are useful to him in verbal communication. Numerous studies, the Rinsland Study for example (4), have attempted to determine children's uses of words and these studies have, in turn, been important sources for word selection. Because monosyllabic words tend to be among the most frequently used words of the American-English core lexicon, it is easy to see why these types of words predominate in beginning spelling and reading programs.

Structural simplicity, on the other hand, refers to the idea that the words a child initially encounters in learning to spell and read should be controlled in terms of their structural complexities. Monosyllabic words, of course, do not necessitate that the child concern himself with such linguistic factors as syllabication and affixation. Monosyllabic words are, in short, the simplest structural forms of the lexicon and therefore are assumed to be the logical starting points for subsequent structural analysis of written language.

Structural simplicity, however, has a second important consequence, particularly in light of recent linguistic insights into the nature of American-English orthography. In order to understand this consequence, we should first examine briefly the notion of an alphabetic orthography, since this is the principle upon which American-English orthography is based.

An alphabetic orthography is based upon the idea that the constituent speech sounds of oral language--the phonemes of a language--each have individual graphic representations in writing. The majority of the world's writing systems are of this type chiefly because alphabetic orthographies are more efficient than other types of orthographies. "Word" writing systems (technically, such systems are called logographic orthographies), for example, employ graphic symbols to represent the morphemes, or meaning elements of a language. These writing systems do have the advantage of circumventing various language forces, such as sound change and dialect, that can interfere in the translation of speech into writing and vice versa. But logographic writing systems also require their users to master a prodigious number of graphic symbols if they are to use this type of writing system; for each word of oral language requires its own graphic symbol.

A second type of orthography is called a syllabary. In such writing systems, graphic symbols are devised to represent the syllables that, in combination, make up the words of a language. Syllabic writing is an improvement over logographic writing because there are fewer syllables than words in a language and therefore fewer graphic symbols that must be mastered in order to spell and read. Yet, syllabically-based orthographies still require substantial "memory loads."

An ideal alphabetic orthography, on the other hand, employs only as many graphic symbols as there are phonemes (speech sounds) in oral language. A thirty-phoneme language, for example, would use only thirty distinct graphic symbols to represent these phonemes in writing. Theoretically, at least, an individual should be able to spell and read correctly any written representation of a spoken word once he has mastered the ability to differentiate speech sounds and has mastered their graphic representations.

American-English orthography is alphabetically based. It uses alphabet letters and their combinations to represent the phonemes of American-English speech. We are all keenly aware, however, that our writing system does not attain the idealized state of a pure alphabetic orthography. But it is based upon this principle;and for this reason, linguists and others propose that a basic, indeed crucial, aspect of a child's understanding of written language involves his understanding the nature of the American-English orthography. Most important, too, it is argued that a knowledge of the alphabetic structure of the orthography can be applied as important components of mastering written American English.

But, because American-English orthography does not truly reflect the alphabetic principle, we cannot rely with complete assurance upon the

knowledge that a given phoneme is spelled a certain way. In our orthography we are forced to play odds; we are obliged to determine which graphemic representation of a phoneme most often represents that phoneme in words and we must also master those exceptional phoneme-grapheme correspondences which exist in the orthography. For, the basic reason underlying our orthography's disparity with the alphabetic principle lies not only in the fact that we have but twenty-six letters to represent some three dozen or so phonemes but that we use these letters in various combinations, with the consequence that we have far more graphic symbols than necessary.

In any case, the notion of structural simplicity, in linguistic terms, also refers to the need to control the selection of words for beginning spelling and reading such that the dominant sound-to-letter correspondences are mastered initially by children before they progress toward more complex or less productive orthographic characteristics. Such linguistically based reading programs as the Bloomfield-Barnhardt materials typify this condition.

DIFFERENCES BETWEEN SPELLING AND READING PROCESSES

The discussion to this point has been directed toward an understanding of the nature of American-English orthography. But, particularly in terms of the study reported here, it should also be noted that the processes of spelling and reading differ in an alphabetic orthography. At the risk of oversimplification, spelling is an encoding operation. The speller's task is to translate speech sounds into writing, a task that necessitates the development of an ability to select from a set of possible graphic representations of a phoneme that graphic symbol which correctly represents the phoneme in the word to be spelled. Reading processes, on the

other hand, involve decoding operations. Reading an alphabetic orthography, in short, requires an individual to determine which of several possible phonemes is represented by a given graphic symbol in a word.

In sum, spelling involves sound-to-letter correspondences while reading involves letter-to-sound correspondences. In a pure alphabetic orthography these processes are reciprocal. But in an imperfect alphabetic orthography such as the American-English writing system, spelling and reading have their own unique complexities. The distinction, while useful for analytic purposes, also has important educational consequences.

PHONEME-GRAPHEME CORRESPONDENCES IN MONOSYLLABIC WORDS

The study reported here involves the encoding process of spelling. Its purpose is not particularly to identify educational implications for beginning spelling and reading programs, but to describe the orthographic structures of monosyllabic words that are or could be used in such programs and to demonstrate a technique that might be useful in examining the orthography for reading purposes.

A recently completed study of phoneme-grapheme correspondences in American-English orthography (1) analyzed the spellings of over 17,000 different words to determine the degree to which this core vocabulary of American-English approximates the alphabetic principle. The findings of this research have been reported elsewhere in the literature (1, 2, 3); but these findings may be summarized quickly by noting that the researchers found that most phonemes are typically represented at least 80 per cent of the time by a particular graphic symbol either anywhere in a syllable or in particular positions in syllables. In other words, recalling that in our imperfect alphabetic orthography we must rely on odds that a graphic

symbol will represent a phoneme, American-English orthography is alphabetically based; but we must utilize cues in addition to simple sound-to-letter correspondence to spell correctly American-English words, using alphabetic principles.

The Stanford Research Project did not isolate monosyllabic words for critical analysis; rather, all words in the core American-English orthography were examined, each word being broken down into syllables, with the result that monosyllabic words were treated as syllables rather than as discrete words. The present study isolated the 3428 monosyllabic words of the earlier study and these words were subjected to an examination of their phoneme-grapheme characteristics.

A phonemic classification was devised, a system that employed forty-eight phonemes--twenty-eight consonant and twenty vowels. Conventional phonemic systems, of course, use fewer numbers of phonemes to classify American-English phonology. But, it was felt appropriate for spelling purposes to include phonemic notations for the occurrence of vowel phonemes before /r/, as well as for the consonant clusters /kw/ and /ks/ which have unique orthographic characteristics.

The possible graphemic representations of phonemes used in American-English orthography were then derived from the previous Stanford Research, with some reclassifying of those graphic symbols that include a final letter e as in bake or spoke.

Computer technology was then employed to analyze the phoneme-grapheme correspondences in monosyllabic words in two ways:

1) To examine them in terms of how a given phoneme is spelled anyplace in monosyllabic words. This examination was intended to describe

the orthography of monosyllabic words as though the orthography were ideally alphabetic. No factors were considered, other than how is a sound spelled when it appears in a monosyllabic word. This classification was termed simple phoneme-grapheme correspondence.

2) To examine them in terms of how a given phoneme is spelle. in particular positions in monosyllabic words; that is, initial, medial, and final position of monosyllabic words. This examination thus described the orthography of monosyllabic words using additional cues that are needed to ascertain how some phonemes are spelled in our alphabetically based orthography. This classification was termed positional constraints.

By rank-ordering the spellings of each phoneme at each of these levels of analysis it was therefore possible to assess how nearly each phoneme in monosyllabic words approximates the alphabetic principle. In this way, a determination could be made of the odds that a given phoneme would be represented by a particular graphic symbol at least 80 per cent of the time in monosyllabic words or in some position in them. The 80 per cent criterion is a useful measure of the degree to which the orthography approximates the alphabetic principle, since it means that any phoneme-grapheme correspondence achieving this criterion could be applied to the spelling of monosyllabic words and the resulting spelling would be correct at le.. t four times out of five.

FINDINGS

In terms of the phonological characteristics of monosyllabic words as compared to polysyllabic words, it was found that:

1) All phonemes of the general lexicon are not present in monosyllabic words. The neutral vowel /ə/, occurring in unstressed syllables,

for example, does not occur in monosyllabic words since, by definition, all monosyllabic words, when isolated from running speech, have primary stress.

2) More important for spelling purposes, however, is the apparent fact that the number of spellings of certain phonemes in the general lexicon as classified in the Stanford Research are considerably reduced in numbers when monosyllabic words are separately classified. In the general lexicon, consonant phonemes employ 141 graphic symbols, while in monosyllabic words 89 graphic symbols are employed. This is also true of vowel phonemes. In the general lexicon, 234 graphic symbols are employed to represent vowel phonemes, while in monosyllabic words 156 graphic symbols are used. In short, 130 fewer graphic symbols are used in monosyllabic words than in the general lexicon.

Such reductions in the number of graphemes used to represent phonemes in monosyllabic words as compared to the general lexicon would seem to infer that phoneme-grapheme correspondences in monosyllabic words more nearly approximate the alphabetic principle in these words than in all words of the general lexicon. But, is this the case?

3) At the level of simple phoneme-grapheme corresponderce, American-English phonemes in the general lexicon fail to achieve the 80 per cent criterion (73.13%) while phonemes in monosyllabic words only exceed this criterion, (81.36%). Mean percentage tabulations, however, obscure the important information concerning consonant and vowel phonemes, respectively, as well as individual phonemes. Consonant phonemes as a group increase in approximations to the alphabetic principle from 83.99% to 88.35% at the level of simple phoneme-grapheme correspondence. Vowel phonemes as a group also increase, but from 62.27% to 64%, well below the 80% criterion.

4) In terms of positional constraints, consonant phonemes further approximate the alphabetic principle in each position of monosyllabic words as compared to their occurrences in the total lexicon. Vowel phonemes, on the other hand, also approach this principle although in no position do vowel phonemes exceed the 80 per cent criterion. Table I summarizes approximations to the alphabetic principle of the total phonemic system used in this study as well as the separate consonant and vowel classifications. This table

TABLE I

SUMMARY TABLE OF PERCENTAGES OF APPROXIMATION TO ALPHABETIC PRINCIPLE OF PHONEMES IN MONOSYLLABIC WORDS

Phonological Level:	48 Phoneme Classification		28 Consonant Classification		20 Vowel Classification	
	No. of Phonemes Used	%	No. of Phonemes Used	%	No. of Phonemes Used	%
Simple Phoneme-Grapheme Corres.	48	81.36	28	88.35	20	64.00
Position Factors						
Initial	43	95.17	24	96.00	19	73.77
Medial	39	80.37	19	98.08	20	68.48
Final	33	81.46	23	83.15	10	59.66
Mean %		84.92		91.71		68.05

also points out how position affects the numbers of phonemes that are used in respective positions in monosyllabic words.

Findings such as the foregoing provide us with general information about the orthography. But they do not help us determine the conditions

that characterize American-English orthography's departure from the alphabetic principle.

5) Twenty-four of the twenty-eight consonant phonemes classified in this study exceed the 80 per cent criterion at the level of simple phoneme-grapheme correspondence. The four phonemes that do not are /j/, /k/, /ng/, and /z/. However, all consonant phonemes exceed this criterion when positional constraints are considered. That is, even the four errant phonemes which fail to exceed the 80 per cent criterion at the level of simple correspondence do so in some position in monosyllabic words. Clearly, then, consonant phonemes as a group are not primarily responsible for American-English orthography's departure from the alphabetic principle.

6) On the other hand, only seven of the twenty vowel phonemes classified in this study exceed the 80 per cent criterion at the level of simple phoneme-grapheme correspondence, these phonemes being the so-called "short vowel" phonemes and two vowel phonemes occurring before /r/. Even when positional constraints are considered, vowel phonemes as a group do not appreciably increase in approximations to the alphabetic principle, although /oi/, /ou/, and /ɔ/ (the vowel sound in one pronunciation of law) exceed the 80 per cent criterion in some position in monosyllabic words. In sum, this examination of the orthography of monosyllabic words reveals that the phonemes largely responsible for the orthography's failure to approximate the alphabetic principle in monosyllabic words are the so-called "long vowel" phonemes and certain diphthongs.

DISCUSSION

Such seeming disparities with the alphabetic principle should not require that we "throw the baby out with the bath water." For the fact of

the matter is that American-English orthography *is* alphabetically based and, although *as a system* is more complicated than it might be, contains many sound-to-letter correspondences that, if learned, can ease the burden of mastering our writing system. The consonant and "short vowel" phonemes, for instance, are rich sources for helping children to understand the nature of the orthography and to apply this knowledge in correctly spelling words. In fact, it is precisely these phoneme classifications that are so heavily utilized in linguistically-based beginning spelling and reading programs and are often used to initiate traditional phonics-oriented reading programs.

American-English words, however, are obviously comprised of other phonemes having less consistent spellings. What might be done about them? One alternative is to present lists of words, selected for their functionality in writing, in which particular phoneme-grapheme correspondences, although failing to exceed the 80 per cent criterion, occur in large numbers of words. This "spelling pattern" approach, for example, could be used to demonstrate one of the several spellings of the "long" vowel /ow/, the so-called "long *o*" sound spelled *oa*. Although this spelling of /ow/ occurs only 17 per cent of the time in monosyllabic words, 45 of the 51 words in which it occurs are extremely functional words. A number of these words are: *board*, *boat*, *cloak*, *coach*, *coal*, *coast*, *coat*, *croak*, *foam*, *goat*, *groan*, *load*, *loaf*, *loan*, *road*, *roam*, *roar*, *roast*, *soak*, *soap*, and *throat*.

In short, one possible solution is to present *individual* phoneme-grapheme correspondences in terms of the functional words in which they occur. Rare spellings of phonemes would, in this instance, be treated

as exceptions and learned by whatever instructional methods appear to be appropriate.

A second alternative suggests itself, however, when we review the degree to which phonemes approximate the alphabetic principle in monosyllabic words as compared to their spellings in the general lexicon, particularly the spellings of those phonemes which depart farthest from the alphabetic principle in monosyllabic words. The vowel phoneme /ey/, for example (the so-called "long a" sound) in monosyllabic words does not achieve the 80 per cent criterion at the level of simple phoneme-grapheme correspondence nor in any position in these words. But, in the general lexicon, this phoneme is spelled a approximately 81 per cent of the time in the final position of syllables that are not word final. Examples of this observation are: able, crater, lady, radio, acorn, flavor, major, table, baby, gravy, bacon, paper, and cable.

In other words, should we wish to do so, an earlier introduction of the factor of syllabication and affixation into beginning spelling and reading programs would enable children better to understand the alphabetic principle underlying our orthography and to induce useful sound-to-letter correspondences that pertain to the total lexicon. Such an alternative, of course, necessitates that words be selected with precision and with a concern for their functionality. But, the concepts of functionality and structural simplicity which were discussed at the outset of this report are not either-or propositions. What is suggested here is that balanced spelling programs must contend with both criteria; that is, if we wish to provide pupils with spelling content that accurately describes the alphabetic structure of the orthography and has utility for them as well.

The purpose of this study, however, has not been to search for curriculum implications per se, but to provide a description of the alphabetic nature of the orthography of American-English words and to illustrate a research design and methodology that has potential usefulness for further studies of the orthography in terms of reading. Studies such as this, it is hoped, contribute to a better understanding of the structure of American-English orthography; and with such understanding may well emerge more effective and accurate spelling and reading programs.

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